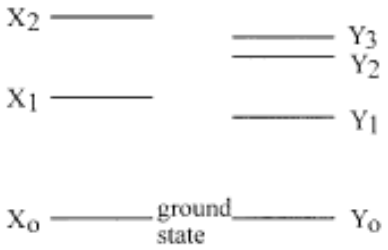
Higher Grade Physics

Unit 2 : PARTICLES & WAVES

Spectra

Energy Transitions

1. Shown in the diagram below are the energy levels for two atoms **X** and **Y**, drawn to the same scale.



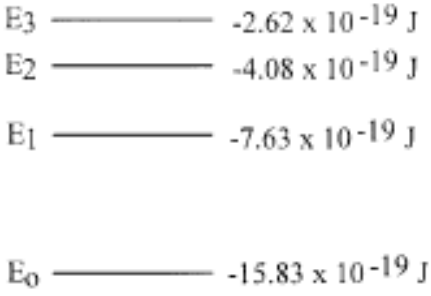
   (a) How many downward transitions are possible between the energy levels of each atom?

   (b) How many lines could appear in the emission spectrum of each element?

   (c) Sketch the energy levels for each atom, showing the possible transitions.

   (d) Which transition in these diagrams will give rise to the emitted radiation of :
   (i) lowest frequency?
   (ii) shortest wavelength?

2. Shown below is the energy level diagram of a particular element.



   (a) How many lines could appear in the emission spectrum of this element?

   (b) Calculate the frequencies of the photons arising from:
   (i) the largest energy transition
   (ii) the smallest energy transition.

   (c) Explain which transition would produce the photons most likely to cause photoemission in a metal.

3. The diagram represents four possible energy levels of an atom of metal.

_____ -5.5×10^{-19} J

_____ -9.4×10^{-19} J

_____ -15.7×10^{-19} J

_____ -24.6×10^{-19} J

(a) How many lines in the spectrum of this metal are produced as a result of transitions between the energy levels shown in the diagram?

(b) Calculate the wavelengths of the spectrum lines representing the greatest and least energy transitions.

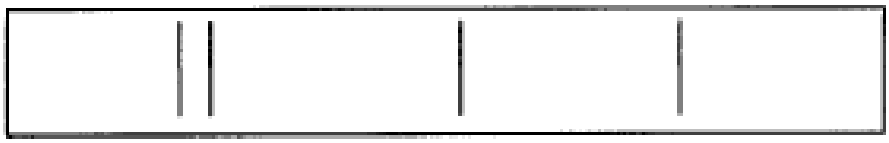
4. Most of the energy emitted by a sodium lamp is in the form of photons of wavelength 589.6 nm.

Which of the following photons could be absorbed by an unexcited sodium atom

(a) a photon of frequency 5.085×10^{14} Hz :
(b) a photon of energy 3.369×10^{-19} J ?

Spectra

5. When the light emitted by a particular material is observed through a spectroscope, it appears as four distinct lines.



(a) What name is given to this kind of emission spectrum?

(b) Explain why a series of specific, coloured lines is observed.

(c) The red line in the spectrum coincides with a wavelength of 680 nm. Calculate the energy of the photons of light that produced this line.

(d) What difference would be observed if the spectroscope was used to examine the light emitted from a torch bulb (filament lamp) ?

Unit 2 : PARTICLES & WAVES

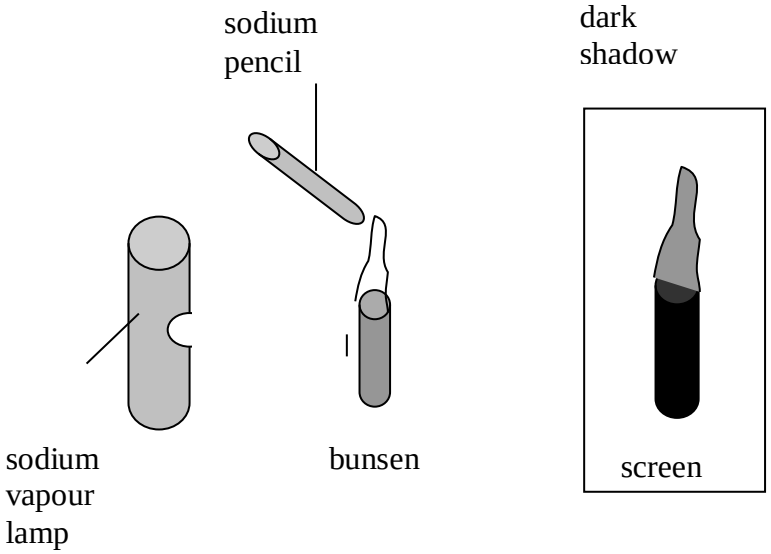
Spectra

6. Explain what happens when white light is shone through a sodium vapour and observed through a diffraction grating ?

7. (a) Explain the presence of the Fraunhofer Lines, the dark lines that appear in the spectrum of sunlight.

   (b) How are the Fraunhofer Lines used to determine the gases that are present in the solar atmosphere?

8. A bunsen flame is placed between a sodium vapour lamp and a screen as shown. A sodium 'pencil' is put into the flame to produce vaporised sodium in the flame.



   (a) Explain why a dark shadow of the flame is seen on the screen.

   (b) The sodium vapour lamp is now replaced with a cadmium vapour lamp. Explain why there is now no dark shadow of the flame on the screen.